Resilience of temperate reefs

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Understanding the resilience of ecosystems has become increasingly important as we seek to determine the impacts of anthropogenic disturbance and to identify thresholds of ecosystem resilience. We ran a number of experiments on the shallow reefs of Port Phillip Bay, Victoria. An initial experiment looked at the effects of two different kinds of disturbance (removal from holdfast or canopy cropping) at two levels (50% or 100% of the plants) on the common kelp *Ecklonia radiata*. We aimed to understand how this species responds to varying levels of disturbance and how this influences the rest of the community. A second experiment looked at areas overgrazed by the native sea urchin *Heliocidaris* erythrogramma, resulting in so-called sea urchin 'barrens'. Urchin barrens associated with this species are not well understood; thus we aimed to determine if the algal canopy could return if all or half of the sea urchins are removed. Results thus far demonstrate that *Ecklonia* is very resilient to canopy removal. The canopy recovered within a few months, with only mild impacts on other species observed. When whole plants were removed, other species moved in to take advantage of the free space until *Ecklonia* could recruit back into plots, which happened relatively quickly. We saw a different story in the case of the sea urchin barrens: here, the time scale taken for recovery was much longer and was hampered by other environmental factors including sedimentation. Monitoring is ongoing and there is currently little difference between control plots and those where urchins have been reduced to half the density, but even full urchin exclusion plots have demonstrated little change. The response of these communities can be both predictable and surprising, as we try to understand what makes these communities resilient.

Significant variation in spawning frequency of common coral trout, *Plectropomus leopardus*, on the Great Barrier Reef

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Obtaining accurate estimates of spawning frequency is fundamental for understanding the reproductive biology of species with indeterminate fecundity, and vital when calculating annual fecundity. Despite this, spawning frequency is not well quantified for many tropical fishes, even those subjected to commercial harvesting. We investigated the relationship between spawning frequency and maternal size and age for the common coral trout *Plectropomus leopardus*, the most commercially important finfish on the Great Barrier Reef (GBR). Four GBR regions were sampled (Lizard Island, Townsville, Mackay, Storm Cay), over four years (1998 – 2001), and compared between fished and protected reefs. Spawning frequency was determined histologically using the post-ovulatory follicle (POF) method. Of the 2481 coral trout ovaries histologically classed as mature, 23.7% contained POFs <24 h old, indicating coral trout spawn approximately every 4.22 days. Logistic regression revealed there was no effect of maternal size or age on spawning frequency. Spawning frequency decreased significantly with increasing latitude. Townsville and Lizard Island's mature females spawned every 2.91 and 3.96 days, respectively, compared with every 16.17 and 20.25 days for Mackay and Storm Cay's females. Spawning frequency also varied with year, peaking in all regions in 1998 or 1999. Marine reserve status had a significant but varied effect on spawning frequency. Storm Cay and Lizard Island's females spawned almost twice as often on fished than protected reefs. In contrast, Townsville's protected females spawned twice as often in protected reefs, and in Mackay's fished reefs no female spawners were found over the 4 years of sampling while protected females spawned every 13 days. Given the decreased spawning activity in the southern GBR and extended spawning during all lunar phases in the central and northern GBR a regional approach to the management of coral trout reproduction, particularly the timing and duration of spawning closures is considered more appropriate than the current model. The results also highlight the importance of multi-year studies to determine the extent of annual variation in reproductive parameters.